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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of	**MAIL STOP APPEAL BRIEF-PATENTS**
Tuqiang Ni et al.	Group Art Unit: 1763
Application No.: 09/788,365	Examiner: Rudy Zervigon
Filed: February 21, 2001	Appeal No.: Unassigned
For: GAS INJECTION SYSTEM FOR PLASMA PROCESSING	

RESPONSE TO NOTIFICATION OF NON-COMPLIANT APPEAL BRIEF (37 CFR 41.37)

Mail Stop APPEAL BRIEF - PATENTS
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

This is a reply to the Notification of Non-Compliant Appeal Brief (37 CFR 41.37), dated March 15, 2007. Submitted herewith is a "Supplemental Appeal Brief," which includes the status of all claims and references to the specification for claims 25, 39, 41 and 42.

A copy of the date-stamped postcard evidencing receipt of the filing fee for the Appeal Brief by the U.S. Patent and Trademark Office is attached.

Should there by any questions regarding this reply, the undersigned can be reached at the number below.

Respectfully submitted,

BUCHANAN INGERSOLL & ROONEY PC

Date April 6, 2007

By: _____
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Patent Response Postcard

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Inventor: Tuqiang Ni et al. **Appln. No.:** 09/788,365 **Filing Date:** February 21, 2001

Docket No.: 1015290-000517 **Filing Atty.:** Edward A. Brown **Date:** January 16, 2007

Title: GAS INJECTION SYSTEM FOR PLASMA PROCESSING

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The following was/were received in the U.S. Patent and Trademark Office on the date stamped hereon:

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- ☐ Amendment/Reply Transmittal Letter
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- ☐ Submission of Formal Drawings w/_____ sheet(s) of drawings (Fig(s). 1-_____
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- ☒ **Appeal Brief**
- ☐ Request for Oral Hearing
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- ☐ Filed by Certificate of Mail
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Attorney's Docket No. 1015290-000517

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of	
Tuqiang Ni et al.	Group Art Unit: 1763
Application No.: 09/788,365	Examiner: Rudy Zervigon
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SUPPLEMENTAL APPEAL BRIEF

Mail Stop APPEAL BRIEF - PATENTS
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

This appeal is from the decision of the Primary Examiner dated August 10, 2006, finally rejecting claims 25 and 28-45. Claims 25, 28-36 and 38-45 are reproduced as the Claims Appendix of this brief.

Appellant paid the fee of $500.00 for filing the Appeal Brief on January 16, 2007. Accordingly, no further fees are required for this submission.

The Commissioner is hereby authorized to charge any appropriate fees under 37 C.F.R. §§1.16, 1.17, and 1.21 that may be required by this paper, and to credit any overpayment, to Deposit Account No. 02-4800.

I. Real Party in Interest

The present application is assigned to Lam Research Corporation ("Lam"). Lam is the real party in interest, and is the assignee of Application No. 09/788,365.

II. Related Appeals and Interferences

The Appellants' legal representative, or assignee, does not know of any other appeal or interferences, which will affect or be directly affected by, or have bearing on, the Board's decision in the pending appeal.

III. Status of Claims

Claims 25, 28-36 and 38-45 are pending in this application.[1] Claims 25 and 28-45 were finally rejected in the Official Action dated August 11, 2006. Claims 25, 28-36 and 38-45 are being appealed.

IV. Status of Amendments

An Amendment Under 37 C.F.R. § 41.33(a) was filed on January 11, 2007, subsequent to mailing of the final Official Action.

V. Summary of Claimed Subject Matter

Claims 25, 28-36 and 38-45 are directed to a gas injector for supplying process gas to a plasma processing chamber wherein a semiconductor substrate is

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[1] Claim 37 was cancelled in the Amendment After Final Rejection filed on January 11, 2007.

subjected to plasma processing. Claims 25, 39, 41 and 42 are independent claims. A concise explanation of the subject matter defined in Claims 25, 39, 41 and 42, including references to exemplary locations in the specification and drawings follows.

A. Claim 25

Claim 25 recites a gas injector (22; see, e.g., FIGs. 1 and 3A to 3C; page 9, line 19; paragraph bridging pages 10-11) for supplying process gas to a plasma processing chamber (10; see, e.g., FIGs. 1 and 2A; page 9, line 8) wherein a semiconductor substrate (13; see, e.g., FIG. 1; page 9, line 9) is subjected to plasma processing. The gas injector comprises gas injector body (40; FIGs. 3A and 3B; page 10, line 24) of dielectric material (see, e.g., page 10, line 8) and sized to extend through a chamber wall of the processing chamber (20; see, e.g., FIGs. 1 and 2A; page 9, lines 16-19) such that a planar axial distal end surface (i.e., bottom surface; see, e.g., FIGs. 1, 2, 3A, 3B) of the gas injector body is exposed within the processing chamber (see, e.g., FIGs. 1 and 2). The gas injector body includes a plurality of gas outlets (46; see, e.g., FIGs. 3A and 3C; page 10, line 25 to page 11, line 3) adapted to supply process gas into the processing chamber. The gas outlets are located in the planar axial distal end surface of the gas injector body (FIGs. 3A and 3C) and the gas outlets are sized to inject the process gas at a subsonic, sonic or supersonic velocity (see, e.g., page 6, lines 2-3).

B. Claim 39

Claim 39 recites a gas injector (22; see, e.g., FIGs. 1 and 3A to 3C; page 9, line 19; paragraph bridging pages 10-11) for supplying process gas to a plasma

processing chamber (10; see, e.g., FIGs. 1 and 2A; page 9, line 8) wherein a semiconductor substrate (13; see, e.g., FIG. 1; page 9, line 9) is subjected to plasma processing. The gas injector comprises a gas injector body (40; FIGs. 3A and 3B; page 10, line 24) sized to extend through a chamber wall of the processing chamber (20; see, e.g., FIGs. 1 and 2A; page 9, lines 16-19) such that an axial distal end surface (i.e., bottom surface; see, e.g., FIGs. 1, 2, 3A, 3B) of the gas injector body is exposed within the processing chamber. The gas injector body includes a plurality of gas outlets (46; see, e.g., FIGs. 3A and 3C; page 11, lines 1-3) adapted to supply process gas into the processing chamber and a cylindrical bore (44; see, e.g., FIGs. 3A and 3C; page 10, line 24) adapted to supply gas to the gas outlets. The cylindrical bore is defined by a sidewall and an endwall which extends radially inwardly from the sidewall. (In FIG. 3A, the sidewall is the axially-extending inner wall of the body 40, while the endwall is the inner wall defining the lower end of the cylindrical bore 44, and which extends radially inwardly from the sidewall.) The gas outlets include a center gas outlet (FIG. 3A) extending from the endwall in the axial direction and a plurality of angled gas outlets (FIG. 3A) extending from the endwall at an acute angle to the axial direction (46; FIG. 3A; page 6, lines 7-9). (The cylindrical bore 44 supplies gas to center gas outlet 46 and to a plurality of angled gas outlets 46, as also depicted in Figure 3C. As shown in Figure 3A, the gas outlets 46 extend from the endwall to the axial end surface (bottom surface) of the body of the gas injector 22.) The gas outlets are located in the axial distal end surface of the gas injector body. The gas injector also comprises an annular flange (42; see, e.g., FIGs. 1, 2, 3A 3B) having a surface (i.e., bottom surface) adapted to overlie and contact an outer surface (i.e., top surface of dielectric window 20; FIGs 1, 2) of the

chamber wall, and a first O-ring (see, e.g., FIG. 1, page 10, line 26; page 13, lines 10-12) in the surface of the flange for sealing against the outer surface of the chamber wall.

C. **Claim 41**

Claim 41 recites a gas injector (22; see, e.g., FIG. 1 and 3A to 3C; page 9, line 19; paragraph bridging pages 10-11) for supplying process gas to a plasma processing chamber (10; see, e.g., FIGs. 1 and 2A; page 9, line 8) wherein a semiconductor substrate (13; see, e.g., FIG. 1; page 9, line 9) is subjected to plasma processing, the gas injector comprises a gas injector body (40; FIGs. 3A and 3B; page 10, line 24) sized to extend through a chamber wall of the processing chamber (20; see, e.g., FIGs. 1 and 2A; page 9, lines 16-19) such that an axial distal end surface (i.e., bottom surface; see, e.g., FIGs. 1, 2, 3A, 3B) of the gas injector body is exposed within the processing chamber, the gas injector body including a plurality of gas outlets (46; see, e.g., FIGs. 3A and 3C; page 11, lines 1-3) adapted to supply process gas into the processing chamber, wherein the gas outlets are located in the axial distal end surface of the gas injector body (FIGs. 3A and 3C) and the gas outlets being sized to inject the process gas at a subsonic, sonic or supersonic velocity (see, e.g., page 6, lines 2-3), wherein the gas injector body includes a uniform diameter central bore (i.e., the diameter is constant along the entire length of the central bore adapted to supply gas to the gas outlets), the central bore extending axially from an upper axial end face (i.e., top surface of gas injector 22; see, e.g., FIGs. 3A and 3B) of the gas injector body, the central bore being defined by a cylindrical sidewall (i.e., the axially-extending inner wall of the body 40) and a

circular, planar endwall (i.e., the inner wall defining the lower end of the central bore 44) extending between the cylindrical sidewall, inlets of the gas outlets being located on the planar endwall (see, e.g., FIG. 3A).

D. Claim 42

Claim 42 recites a gas injector (22; see, e.g., FIG. 1 and 3A to 3C; page 9, line 19, paragraph bridging pages 10-11) for supplying process gas to a plasma processing chamber (10; see, e.g., FIGs. 1 and 2A; page 9, line 8) wherein a semiconductor substrate (13; see, e.g., FIG. 1; page 9, line 9) is subjected to plasma processing. The gas injector comprises a gas injector body (40; FIGs. 3A and 3B; page 10, line 24) made of a dielectric material selected from the group consisting of quartz, alumina and silicon nitride (page 10, line 8) and sized to extend through a chamber wall (20; see, e.g., FIGs. 1 and 2A; page 9, lines 16-19) of the processing chamber such that a planar axial distal end surface (i.e., bottom surface; see, e.g., FIGs. 1, 2, 3A, 3B) of the gas injector body is exposed within the processing chamber. The gas injector body includes a plurality of gas outlets (46; see, e.g., FIGs. 3A and 3C; page 11, lines 1-3) adapted to supply process gas into the processing chamber. The gas outlets 46 are located in the planar axial distal end surface of the gas injector body (FIGs. 3A and 3C) and the gas outlets being sized to inject the process gas at a subsonic, sonic or supersonic velocity (see, e.g., page 6, lines 2-3).

VI. Ground of Rejection to be Reviewed on Appeal

The rejection of Claims 25 and 28-45 under 35 U.S.C. § 103(a) over U.S. Patent No. 5,935,373 to Koshimizu ("Koshimizu") in view of U.S. Patent No. 4,439,401 to Voll et al. ("Voll").

VII. Argument

A. Legal Standards for Obviousness

As set forth in 35 U.S.C. § 103(a):

> A patent may not be obtained though the invention is not identically disclosed or described ... if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. (Emphasis added.)

Obviousness depends on 1) the scope and content of the prior art; 2) the differences between the claimed invention and the prior art; 3) the level of ordinary skill in the art; and 4) any relevant secondary considerations, including commercial success, long felt but unsolved needs, and failure of others. *Graham v. John Deere Co.*, 383 U.S. 1, 17 (1966).

Rejections under 35 U.S.C. § 103 must be based on "evidence relevant to the finding of whether there is a teaching, motivation, or suggestion to select and combine the references relied on as evidence of obviousness." *In re Lee*, 277 F.3d 1338, 1343, 61 USPQ2d 1430, 1434 (Fed. Cir. 2002). "Particular findings must be made as to the reason the skilled artisan, with no knowledge of the claimed invention, would have selected these components for combination in the manner

claimed" (emphasis added). *Id.* Moreover, "the [Office] must identify specifically the principle, known to one of ordinary skill, that suggests the claimed combination." *Id.*

To avoid impermissible hindsight reconstruction of the prior art, it is necessary "to consider the thinking of one of ordinary skill in the art at the time of the invention and guided only by the prior art references and then-accepted wisdom in the field." *In re Kotzab*, 217 F.3d 1365, 1369, 55 USPQ2d 1313, 1316 (Fed. Cir. 2000). The teaching, suggestion or motivation to modify the primary (base) reference "may come explicitly from statements in the prior art, the knowledge of one of ordinary skill in the art, or, in some cases the nature of the problem to be solved." *Kotzab*, 217 F.3d at 1370, 55 USPQ2d at 1317. The teaching, motivation or suggestion may be implicit from the prior art as a whole, rather than expressly stated in the references. *Id.* The test for an implicit showing is what the combined teachings, knowledge of one of ordinary skill in the art, and the nature of the problem to be solved as a whole would have suggested to those of ordinary skill in the art. *Id.* If the Office relies on an express or implicit showing, it must provide particular findings related thereto. *Id.*

As set forth in *In re Rouffet*, 149 F.3d 1350, 1357, 47 USPQ2d 1453, 1457-58 (Fed. Cir 1998):

> To prevent use of hindsight based on the invention to defeat patentability of the invention, this court requires the examiner to show a motivation to combine the references that create the case of obviousness. In other words, the examiner must show reasons that the skilled artisan, confronted with the same problems as the inventor and with no knowledge of the claimed invention, would select the elements from the cited prior art references for combination in the manner claimed. (Emphasis added).

As set forth in MPEP § 2143.03, "[t]o establish *prima facie* obviousness of a claimed invention, all the claim limitations must be taught or suggested by the prior art" (emphasis added, citation omitted). As set forth in MPEP § 2143.02, there must

be a reasonable expectation of success to establish *prima facie* obviousness of claimed subject matter. "The teaching or suggestion to make the claimed combination and the reasonable expectation of success must be found in the prior art, not in applicant's disclosure" (emphasis added, citation omitted).

B. Rejection of Claims 25 and 28-45 under 35 U.S.C. § 103(a) over Koshimizu in view of Voll

1. Claims 25, 33, 34 and 38

Claim 25 recites a gas injector for supplying process gas to a plasma processing chamber wherein a semiconductor substrate is subjected to plasma processing. The gas injector comprises, *inter alia*, a gas injector body of dielectric material and sized to extend through a chamber wall of the processing chamber such that a planar axial distal end surface of the gas injector body is exposed within the processing chamber, the gas injector body including a plurality of gas outlets adapted to supply process gas into the processing chamber, wherein the gas outlets are located in the planar axial distal end surface of the gas injector body (emphasis added). In the exemplary embodiment of the gas injector shown in Figure 3A, the axial distal end surface of the gas injector body is the bottom surface of the gas injector body. Gas outlets 46 are located in the planar axial distal end surface.

The claimed gas injector is used in a plasma processing chamber in which plasma is generated by an RF energy source. The claimed gas injector can improve etch uniformity, center-to-edge profile uniformity, critical dimension (CD) bias and/or profile microloading (page 8, lines 13-15). Figure 4 shows a uniform etch by-product distribution above the exposed surface of a wafer achieved by the claimed gas injector. Specification at page 11, lines 16-23. As shown, a substantially uniform

etch by-product distribution was achieved across a wafer surface. Figure 5 depicts a substantially uniform chlorine atom distribution intensity achieved for a wafer with the claimed injector. Figures 6a-6c show SEM images of etch profiles in polysilicon dense lines and Figures 6d-6f are SEM images of etch profiles in polysilicon isolated lines for different regions of a wafer. The SEM images show that the etch profile is substantially uniform across the wafer. Figures 7a-7d show additional exemplary etch results produced using the claimed gas injector.

Appellants submit that the combination of Koshimizu (directed to a plasma processing apparatus including a vacuum chamber in which a wafer is processed) and Voll (directed to a liquid atomizer) does not suggest the gas injector for supplying process gas to a plasma processing chamber recited in Claim 25, and thus does not support the rejection.

The plasma processing apparatus shown in Figure 1 of Koshimizu comprises a processing vessel 102 including an insulator 108 and a processing gas port 156 with a single gas outlet formed in the insulator 108. Koshimizu at column 5, lines 41-45. Koshimizu does not disclose the material forming the processing gas port 156. An RF antenna 112 is positioned on the outer wall surface of the insulator 108. Koshimizu at column 3, lines 52-54.

According to Koshimizu, plasma processing apparatuses of the antenna RF induction-type have the following technical problems: 1) the plasma is difficult to generate, 2) hunting occurs between the divided antennas, and 3) etching selectivity and etching shape must be controlled. Koshimizu at column 1, lines 41-46. Koshimizu discloses that its disclosed apparatus solves these problems by means of one or more of the following features and improvements: 1) "the plasma generation

RF power supply unit has phase control means for controlling the phases of the RF powers to be supplied to the first and second RF antennas"; 2) "the bias RF power supply unit has phase control means for controlling the phase of the RF power to be supplied to the lower electrode"; and 3) "the plasma generation RF power supply unit has phase control means for controlling the phases of the respective RF powers to be supplied to the first and second RF antennas, and that the bias RF power supply unit has phase control means for controlling the phase of the RF power to be supplied to the lower electrode." Koshimizu at column 2, lines 12-15; lines 16-19; 29-32 and 46-52. Koshimizu discloses that the apparatus provides an "improvement in uniformity of a plasma generated in a plasma processing apparatus, an increase in plasma generation efficiency, an increase in processing precision, a reduction in damage to a substrate, and the like." Koshimizu at column 1, lines 9-12.

Thus, Koshimizu discloses that the apparatus already achieves plasma uniformity and processing precision. Koshimizu discloses that these results are provided by the provision of the disclosed bias RF power supply unit for supplying power to the RF antennas and lower electrode of the plasma processing apparatus. Koshimizu does not suggest that the construction of the processing gas port 156 is responsible for the plasma uniformity and processing precision that is achieved by the apparatus. Nor does Koshimizu suggest that the apparatus suffers from any problem that would be overcome by modifying or replacing the single-outlet processing gas port 156.

The Examiner admitted that Koshimizu does not teach the following features of Claim 25:

1) a gas injector comprising a body of dielectric material;

2) a plurality of gas outlets adapted to supply process gas into a processing chamber; and

3) gas outlets located in a planar axial distal end surface of a gas injector. Final Official Action at page 4, points (i) and (ii).

Despite these multiple, structural differences between Koshimizu's processing gas port 156 and the claimed gas injector, the Examiner alleged that it would have been obvious to replace Koshimizu's gas supply port with the non-analogous "gas injector" shown in Figure 10 of Voll. Final Official Action at page 7, lines 16-18. Appellants respectfully disagree.

Voll does not relate to the plasma processing of semiconductor wafers. Instead, Voll discloses a process for producing carbon black. Voll's process uses a hot furnace including a binary nozzle for spraying a hydrocarbon-containing liquid carbon black feedstock into the hot gaseous atmosphere of the furnace to produce carbon black (column 1, lines 12-17).

Voll describes certain disadvantages of the described binary and unary atomizing nozzles for atomizing carbon black liquid feedstock with and without the use of a propellant (atomizing gas). Voll at column 1, line 18 to column 2, line 26. The binary atomizing nozzles use a propellant to form an aerosol containing droplets of the liquid carbon black feedstock, which is sprayed into hot reaction gases in a furnace by the nozzle. In other words, such nozzles spray a two-phase fluid. The unary nozzles do not use a propellant, but also form droplets of the liquid carbon

black feedstock, which are sprayed into hot reaction gases in a furnace. According to Voll, such binary and unary atomizing nozzles are unable to achieve satisfactory liquid drop spraying angles and also do not produce a satisfactory liquid droplet size and vaporization speed of the liquid carbon black feedstock. Voll at column 1, lines 65-68 and column 2, lines 15-19.

Voll's process and apparatus is directed to overcoming these particular disadvantages of such binary and unary atomizing nozzles that produce droplets of the liquid carbon black feedstock in carbon black production. Voll's process for the production of carbon black in a flow reactor comprises spraying hydrocarbon-containing liquid carbon black feedstock using a propellant gas into a stream of hot reaction gases produced by burning fuel in a furnace. Voll's preferred propellant gas is air or steam. Voll at column 2, line 52. Voll's process uses a binary atomizing nozzle constructed to produce an aerosol containing droplets of the liquid carbon black feedstock. The liquid droplets are sprayed into hot reaction gases in a furnace chamber 18 to produce carbon black. Voll at column 3, lines 12-18 and 40-68; and Figure 11.

Voll depicts different binary nozzle constructions in Figures 1 to 10. The binary nozzles 4 include channels 3 through which the mixture of the liquid feedstock and propellant pass. The channels 3 of the nozzles are configured to atomize the liquid when the propellant is released through the channels 3 to thereby form an aerosol containing liquid droplets of the carbon black feedstock.

a. Voll is Non-Analogous Prior Art

Voll does not qualify as analogous prior art with respect to the claimed gas injector. According to MPEP § 2141.01(a), a reference does not qualify as

analogous prior art under 35 U.S.C. § 103 unless it is (1) in the field of applicant's endeavor, or, if not, (2) reasonably pertinent to the particular problem with which the inventor was concerned. *See In re Oetiker*, 977 F.2d 1443, 1447, 24 USPQ2d 1443 (Fed. Cir. 1992). As stated in *In re Kahn*, 441 F.3d 977, 987, 78 USPQ 1329, 1336 (Fed. Cir. 2006):

> We have explained that this test begins the inquiry into whether a skilled artisan would have been motivated to combine references by defining the prior art relevant for the obviousness determination, and that it is meant to defend against hindsight (emphasis added).

The "problem" prong of the analogous prior art test is explained in *In re Clay*, 966 F.2d 656, 659-60, 23 USPQ2d 1058, 1061 (Fed. Cir. 1992):

> If a reference disclosure has the same purpose as the claimed invention, the reference relates to the same problem, and that fact supports use of that reference in an obviousness rejection. An inventor may well have been motivated to consider the reference when making his invention. If it is directed to a different purpose, the inventor would accordingly have had less motivation or occasion to consider it. (Emphasis added).

Voll fails to meet either one of the two requirements of the analogous prior art test.

The claimed gas injector is constructed to supply process gas to a plasma processing chamber in which a semiconductor substrate is processed. The purpose of the claimed gas injector is to supply process gas in a manner so as to improve processing uniformity and efficiency in processing semiconductor substrates in the plasma processing chamber.

In contrast, Voll's liquid spray nozzle is designed specifically to atomize carbon black liquid feedstock using a propellant gas, and to spray the liquid droplets into a stream of hot reaction gases produced by burning a fuel. The nozzle is

specifically designed to produce liquid droplets of a certain size and to spray such droplets in a certain spray pattern into such hot reaction gases. Noll's nozzle is not a gas injector for supplying a process gas to a plasma processing chamber.

Voll is not directed to the field of semiconductor plasma processing, which involves vacuum processing conditions and the need for using highly pure materials to avoid the contamination of substrates being processed in the chamber. In stark contrast, Voll is directed to the unrelated field of carbon black production in a hot furnace chamber by producing atomized liquid droplets of carbon black feedstock, and spraying the liquid droplets into hot gases in the furnace chamber to produce the carbon black. Such furnaces are substantially different from a plasma processing chamber in which semiconductor substrates are processed under high-purity conditions.

Secondly, Voll is not reasonably pertinent to the problem of providing a gas injector for improving processing uniformity and efficiency for processing semiconductor substrates in such plasma processing chambers. In contrast to processing semiconductor wafers, Voll is directed to the problem of providing certain liquid drop spraying angles and liquid droplet size and vaporization speed of the liquid carbon black feedstock. Voll's carbon black production process is unrelated to semiconductor plasma processing for various reasons. For example, Voll's process uses: a) a liquid feedstock/propellant mixture instead of a process gas; b) sprayed liquid droplets instead of supplying process gas; and c) a hot gas furnace atmosphere instead of a high-purity vacuum environment. The Examiner has not explained why one skilled in the art of plasma processing of semiconductor substrates in a plasma processing chamber would have looked to the unrelated field

of carbon black production in a furnace for a solution to the problem of providing a gas injector for improving processing uniformity and efficiency in the plasma processing of semiconductor substrates in a plasma processing chamber.

Thus, because Voll is neither in the field of applicant's endeavor nor reasonably pertinent to the particular problem with which the inventor was concerned, Voll does not qualify as analogous prior art with respect to the claimed subject matter.

b. The Combination of Koshimizu and Voll Does Not Suggest Every Claimed Feature

Even if Koshimizu and non-analogous Voll were combined in the manner advanced by the Examiner, the combination of Koshimizu and Voll still would not have suggested every claimed feature.

Firstly, Voll does not disclose a "gas injector" as alleged in the final Official Action. Rather, Voll discloses binary nozzles for atomizing liquid feedstock using a propellant. Voll does not suggest any nozzle structure that would be suitable for supplying a process gas to a plasma processing chamber, much less the claimed gas injector. Accordingly, Voll does not suggest replacing or modifying Koshimizu's gas injector.

Secondly, Voll does not disclose the material of the binary nozzle. As such, replacing Koshimizu's gas supply port with Voll's nozzle, or modifying Koshimizu's gas supply port in view of Voll, would not have resulted in a gas injector including a gas injector body made of a dielectric material, as recited in Claim 25.

Thirdly, as acknowledged by the Examiner, none of the nozzle constructions shown in Figures 1-10 of Voll includes a body having a planar axial distal end surface and a plurality of gas outlets located in the planar axial distal end surface.

The nozzle 4 shown in Figure 10 of Voll includes no gas outlets in the planar axial distal end surface (i.e., the left-most surface of the nozzle 4), but only includes gas outlets in a surface adjacent the planar axial distal end surface. The nozzles shown in Figures 2 and 4 of Voll include a planar axial distal end surface with no gas outlets. The nozzle shown in Figure 9 of Voll includes a pointed distal end with no gas outlets. The nozzles shown in Figures 6 and 8 of Voll each have a conical distal end surface, not a planar axial distal end surface, as recited in Claim 25.

Accordingly, because Voll does not suggest, *inter alia*, a "gas injector body including a plurality of gas outlets adapted to supply process gas into the processing chamber, wherein the gas outlets are located in the planar axial distal end surface of the gas injector body" (emphasis added), replacing Koshimizu's gas supply port with Voll's binary nozzle or modifying Koshimizu's gas supply port in view of Voll, would not have resulted in a gas injector including a gas injector body including these features of Claim 25.

For at least these reasons, replacing Koshimizu's gas supply port with Voll's binary nozzle, or modifying Koshimizu's gas supply port in view of Voll, would not have resulted in a gas injector that includes every feature recited in Claim 25. Thus, the applied references do not support the alleged *prima facie* case of obviousness with respect to Claim 25 for this additional reason.

c. The Office Has Not Established Motivation for Modifying Koshimizu's Gas Supply Port in View of Voll

Koshimizu discloses that certain technical problems of plasma processing apparatus of antenna RF induction type are solved by its bias RF power supply unit. The Examiner has not established any reason why one skilled in the art would have replaced or modified Koshimizu's processing gas port 156 in view of Voll, which

discloses an unrelated liquid spray nozzle designed for carbon black production, to try to solve the problem addressed by the present inventors. Because the Examiner has not shown reasons that one skilled in the art, confronted with the same problems as the inventors and with no knowledge of the claimed gas injector, would have selected the elements from the cited prior art references for combination in the manner claimed, the Examiner has not established a *prima facie* case of obviousness for this additional reason. *In re Rouffet*, 149 F.3d at 1357, 47 USPQ2d 1457-58.

d. The Office Has Not Established a Reasonable Expectation of Success

Voll's nozzle is specifically constructed to achieve certain liquid drop spraying angles and produce a certain liquid droplet size and vaporization speed of liquid carbon black feedstock using a propellant to atomize a liquid feedstock. The Office has not shown that these particular characteristics of sprayed liquid droplets are relevant to supplying a process gas into a vacuum processing chamber, or that Voll's liquid spray nozzle would be suitable for injecting process gas into a vacuum chamber. An "obvious to try" rationale is not the standard under 35 U.S.C. § 103. *See In re O'Farrell*, 853 F.2d 894, 903, 7 USPQ2d 1673, 1680 (Fed. Cir. 1988). Moreover, the Office has not established a reasonable expectation of success, which is required to establish *prima facie* obviousness of claimed subject matter.

Thus, the applied combination of references does not support the alleged *prima facie* case of obviousness with respect to Claim 25 for these additional reasons.

Therefore, the Board is respectfully requested to reverse the rejection of Claim 25 and of Claims 33, 34 and 38, which depend from Claim 25.

2. Claims 28, 31 and 43-45

Claims 28 and 31 depend from Claim 25 and Claims 43-45 depend from Claim 28. Claim 28 recites that "the gas outlets include a center gas outlet extending in the axial direction and a plurality of angled gas outlets extending at an acute angle to the axial direction." Neither Koshimizu nor Voll suggests a gas injector comprising, *inter alia*, a planar axial distal end surface (as recited in Claim 25), much less such gas injector including "a plurality of angled gas outlets extending at an acute angle to the axial direction," as recited in Claim 28.

Claim 31 recites that "the gas outlets include a plurality of angled gas outlets which inject process gas at an acute angle relative to a plane parallel to the distal end surface." Neither Koshimizu nor Voll suggests a gas injector comprising, *inter alia*, a planar axial distal end surface including "a plurality of angled gas outlets," as recited in Claim 31.

Thus, the combination of Koshimizu and Voll does not support the alleged *prima facie* case of obviousness of Claims 28 and 31 for the reasons discussed above with respect to Claim 25, as well as for these additional reasons. Therefore, the Board is respectfully requested to reverse the rejection of Claims 28, 31 and 43-45.

3. Claim 29

Claim 29, which depends from Claim 25, recites the features of "the gas injector includes a planar axial end face which is dimensioned so as to be flush with an interior surface of a dielectric window forming the chamber wall" (emphasis added). The embodiment of the gas injector 22 shown in Figure 2A includes a

planar axial end face (i.e., bottom face including the planar axial distal end surface) flush with an interior surface (i.e., bottom surface) of the dielectric window 20.

In contrast, Koshimizu's gas supply port 156 does not have a "planar axial end face." Voll's nozzles do not include a "planar axial end face dimensioned so as to be flush with an interior surface of a dielectric window forming the chamber wall." As such, even if Koshimizu's gas supply port 156 was replaced with Voll's nozzle, or modified in view of Voll, this modification of Koshimizu would not have resulted in the gas injector recited in Claim 29.

Thus, the combination of Koshimizu and Voll does not support the alleged *prima facie* case of obviousness of Claim 29 for the reasons discussed above with respect to Claim 25, as well as for these additional reasons. Therefore, the Board is respectfully requested to reverse the rejection of Claim 29.

4. Claims 30, 32 and 35

Claims 30, 32 and 35 depend from Claim 25. Claim 30 recites that "the gas injector includes at least one seal adapted to contact the dielectric window when the gas injector is mounted in the dielectric window" (emphasis added). Claim 32 recites that "the gas injector is adapted to be removably mounted in an opening in the chamber wall and includes at least one O-ring providing a vacuum seal between the gas injector and the chamber wall" (emphasis added). Claim 35 recites that "the gas injector body includes at least one O-ring seal on an outer surface of the gas injector body" (emphasis added).

The Examiner acknowledged that Koshimizu does not disclose the features of Claims 30, 32 and 35. Final Official Action at points (iv), (vi) and (vii), pages 4 to 5. The Examiner stated that Voll's gas injector shown in Figure 10 is "sealed for

hermicity," but identified no disclosure in Voll supporting the position that Voll's nozzle includes "at least one seal adapted to contact the dielectric window when the gas injector is mounted in the dielectric window" (emphasis added) recited in Claim 30, or "at least one O-ring seal" recited in Claims 32 and 35.

Accordingly, even if Koshimizu's gas supply port 156 was replaced with Voll's nozzle, or modified in view of Voll, this modification of Koshimizu would not have resulted in the gas injector recited in any one of Claims 30, 32 and 35.

Thus, the combination of Koshimizu and Voll does not support the alleged *prima facie* case of obviousness of Claims 30, 32 and 35 for the reasons discussed above with respect to Claim 25, as well as for these additional reasons. Therefore, the Board is respectfully requested to reverse the rejection of Claims 30, 32 and 35.

5. Claim 36

Claim 36 depends from Claim 25 and recites the features of "the gas injector body includes a first O-ring seal on an outer surface of the gas injector body and a second O-ring seal in a surface of a flange extending from the outer surface of the gas injector body" (emphasis added).

The Examiner acknowledged that Koshimizu does not disclose the features of Claim 36. Final Official Action at point (viii) at page 5. As discussed above, the Examiner stated that Voll's gas injector shown in Figure 10 is "sealed for hermicity," but identified no disclosure in Voll supporting the position that Voll's nozzle includes the first and second O-ring seals recited in Claim 36.

Accordingly, even if Koshimizu's gas supply port 156 was replaced with Voll's nozzle, or modified in view of Voll, this modification of Koshimizu would not have resulted in the gas injector recited in Claim 36.

Thus, the combination of Koshimizu and Voll does not support the alleged *prima facie* case of obviousness of Claim 36 for the reasons discussed above with respect to Claim 25, as well as for these additional reasons. Therefore, the Board is respectfully requested to reverse the rejection of Claim 36.

6. Claims 39 and 40

Independent Claim 39 is directed to a gas injector for supplying process gas to a plasma processing chamber wherein a semiconductor substrate is subjected to plasma processing. The claimed gas injector comprises, *inter alia*, a gas injector body including a plurality of gas outlets adapted to supply process gas into the processing chamber, the gas outlets including a center gas outlet extending from the endwall in the axial direction and a plurality of angled gas outlets extending from the endwall at an acute angle to the axial direction, wherein the gas outlets are located in the axial distal end surface of the gas injector body; and a first O-ring in the surface of the flange for sealing against the outer surface of the chamber wall (emphasis added).

The Examiner acknowledged that Koshimizu does not disclose or suggest a gas injector including a plurality of gas outlets adapted to supply process gas into the processing chamber, wherein the gas outlets are located in the axial distal end surface of the gas injector body; or that the processing gas port 156 includes a first O-ring in a surface of a flange for sealing against the outer surface of a chamber wall, as recited in Claim 39. However, the Examiner alleged that Voll cures the deficiencies of Koshimizu. Appellants respectfully disagree.

First, Voll does not qualify as analogous prior art with respect to the claimed subject matter.

Second, Voll's nozzle does not include an axial distal end surface including a plurality of gas outlets, much less "a center gas outlet extending from the endwall in the axial direction and a plurality of angled gas outlets extending from the endwall at an acute angle to the axial direction," as recited in Claim 39. Voll's nozzle also does not include "a first O-ring in the surface of the flange for sealing against the outer surface of the chamber wall" (emphasis added), as also recited in Claim 39.

As such, even if Koshimizu's gas supply port 156 was replaced with Voll's nozzle, or modified in view of Voll, this modification of Koshimizu would not have resulted in the gas injector recited in Claim 39.

Thus, the combination of Koshimizu and Voll does not support the alleged *prima facie* case of obviousness of Claim 39 for at least these reasons. Therefore, the Board is respectfully requested to reverse the rejection of Claims 39 and 40.

7. Claim 41

Independent Claim 41 is directed to a gas injector for supplying process gas to a plasma processing chamber wherein a semiconductor substrate is subjected to plasma processing. The claimed gas injector comprises, *inter alia*, a gas injector body including a plurality of gas outlets adapted to supply process gas into the processing chamber, wherein the gas outlets are located in the axial distal end surface of the gas injector body (emphasis added).

First, Voll does not qualify as analogous prior art with respect to the claimed subject matter.

Second, Voll's nozzle does not include an axial distal end surface including a plurality of gas outlets, as recited in Claim 41. Accordingly, even if Koshimizu's gas supply port 156 was replaced with Voll's nozzle, or modified in view of Voll, this

modification of Koshimizu would not have resulted in the gas injector recited in Claim 41.

Thus, the combination of Koshimizu and Voll does not support the alleged *prima facie* case of obviousness of Claim 41 for at least these reasons. Therefore, the Board is respectfully requested to reverse the rejection of Claim 41.

8. Claim 42

Independent Claim 42 recites a gas injector for supplying process gas to a plasma processing chamber wherein a semiconductor substrate is subjected to plasma processing. The gas injector comprises, inter alia, a gas injector body made of a dielectric material selected from the group consisting of quartz, alumina and silicon nitride, the gas injector body including a plurality of gas outlets adapted to supply process gas into the processing chamber, wherein the gas outlets are located in the planar axial distal end surface.

First, Voll does not qualify as analogous prior art with respect to the claimed subject matter.

Second, neither Koshimizu nor Voll discloses a gas injector made of a dielectric material, much less the dielectric materials recited in Claim 42. Also, neither of these references discloses a gas injector comprising an axial distal end surface including a plurality of gas outlets, as recited in Claim 42. Accordingly, even if Koshimizu's gas supply port 156 was replaced with Voll's nozzle, or modified in view of Voll, this modification of Koshimizu would not have resulted in the gas injector recited in Claim 42.

Thus, the combination of Koshimizu and Voll does not support the alleged *prima facie* case of obviousness of Claim 42 for at least these reasons. Therefore, the Board is respectfully requested to reverse the rejection of Claim 42.

VIII. Claims Appendix

See the attached Claims Appendix for a copy of the claims involved in the appeal.

IX. Evidence Appendix

See attached Evidence Appendix for copies of evidence relied upon by Appellant.

X. Related Proceedings Appendix

See attached Related Proceedings Appendix for copies of decisions identified in Section II, supra.

Respectfully submitted,

BUCHANAN INGERSOLL & ROONEY PC

Date April 6, 2007

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VIII. CLAIMS APPENDIX

The Appealed Claims

25. (Previously Presented) A gas injector for supplying process gas to a plasma processing chamber wherein a semiconductor substrate is subjected to plasma processing, the gas injector comprising:

gas injector body of dielectric material and sized to extend through a chamber wall of the processing chamber such that a planar axial distal end surface of the gas injector body is exposed within the processing chamber, the gas injector body including a plurality of gas outlets adapted to supply process gas into the processing chamber, wherein the gas outlets are located in the planar axial distal end surface of the gas injector body and the gas outlets are sized to inject the process gas at a subsonic, sonic or supersonic velocity.

28. (Previously Presented) The gas injector of Claim 25, the gas outlets include a center gas outlet extending in the axial direction and a plurality of angled gas outlets extending at an acute angle to the axial direction.

29. (Previously Presented) The gas injector of Claim 25, wherein the gas injector includes a planar axial end face which is dimensioned so as to be flush with an interior surface of a dielectric window forming the chamber wall.

30. (Previously Presented) The gas injector of Claim 29, wherein the gas injector includes at least one seal adapted to contact the dielectric window when the gas injector is mounted in the dielectric window.

31. (Previously Presented) The gas injector of Claim 25, wherein the gas outlets include a plurality of angled gas outlets which inject process gas at an acute angle relative to a plane parallel to the distal end surface.

32. (Previously Presented) The gas injector of Claim 25, wherein the gas injector is adapted to be removably mounted in an opening in the chamber wall and includes at least one O-ring providing a vacuum seal between the gas injector and the chamber wall.

33. (Previously Presented) The gas injector of Claim 25, wherein the gas injector body includes a surface adapted to overlie an outer surface of the chamber wall.

34. (Previously Presented) The gas injector of Claim 25, wherein the gas injector body includes an annular flange adapted to overlie and contact an outer surface of the chamber wall.

35. (Previously Presented) The gas injector of Claim 25, wherein the gas injector body includes at least one O-ring seal on an outer surface of the gas injector body.

36. (Previously Presented) The gas injector of Claim 25, wherein the gas injector body includes a first O-ring seal on an outer surface of the gas injector body and a second O-ring seal in a surface of a flange extending from the outer surface of the gas injector body.

38. (Previously Presented) The gas injector of Claim 25, wherein all of the gas outlets supply process gas through the distal end of the gas injector body.

39. (Previously Presented) A gas injector for supplying process gas to a plasma processing chamber wherein a semiconductor substrate is subjected to plasma processing, the gas injector comprising:

gas injector body sized to extend through a chamber wall of the processing chamber such that an axial distal end surface of the gas injector body is exposed within the processing chamber, the gas injector body including a plurality of gas outlets adapted to supply process gas into the processing chamber and a cylindrical bore adapted to supply gas to the gas outlets, the cylindrical bore being defined by a sidewall and an endwall which extends radially inwardly from the sidewall, the gas outlets including a center gas outlet extending from the endwall in the axial direction and a plurality of angled gas outlets extending from the endwall at an acute angle to the axial direction, wherein the gas outlets are located in the axial distal end surface of the gas injector body;

an annular flange having a surface adapted to overlie and contact an outer surface of the chamber wall; and

a first O-ring in the surface of the flange for sealing against the outer surface of the chamber wall.

40. (Previously Presented) The gas injector of Claim 39, comprising a second O-ring seal on an outer surface of the gas injector body.

41. (Previously Presented) A gas injector for supplying process gas to a plasma processing chamber wherein a semiconductor substrate is subjected to plasma processing, the gas injector comprising:

a gas injector body sized to extend through a chamber wall of the processing chamber such that an axial distal end surface of the gas injector body is exposed within the processing chamber, the gas injector body including a plurality of gas outlets adapted to supply process gas into the processing chamber, wherein the gas outlets are located in the axial distal end surface of the gas injector body and the gas outlets being sized to inject the process gas at a subsonic, sonic or supersonic velocity, wherein the gas injector body includes a uniform diameter central bore adapted to supply gas to the gas outlets, the central bore extending axially from an upper axial end face of the gas injector body, the central bore being defined by a cylindrical sidewall and a circular, planar endwall extending between the cylindrical sidewall, inlets of the gas outlets being located on the planar endwall.

42. (Previously Presented) A gas injector for supplying process gas to a plasma processing chamber wherein a semiconductor substrate is subjected to plasma processing, the gas injector comprising:

gas injector body made of a dielectric material selected from the group consisting of quartz, alumina and silicon nitride and sized to extend through a chamber wall of the processing chamber such that a planar axial distal end surface

of the gas injector body is exposed within the processing chamber, the gas injector body including a plurality of gas outlets adapted to supply process gas into the processing chamber, wherein the gas outlets are located in the planar axial distal end surface of the gas injector body and the gas outlets being sized to inject the process gas at a subsonic, sonic or supersonic velocity.

43. (Previously Presented) The gas injector of Claim 28, wherein the gas injector body includes 8 of the angled gas outlets.

44. (Previously Presented) The gas injector of Claim 28, wherein the acute angle is 10 to 70°.

45. (Previously Presented) The gas injector of Claim 28, wherein the angled gas outlets direct the process gas such that the process gas does not flow directly towards a substrate being processed.

IX. EVIDENCE APPENDIX

None.

X. RELATED PROCEEDINGS APPENDIX

None.